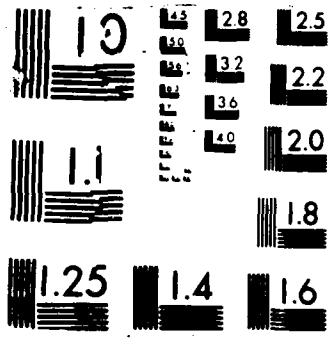
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Optimization and Scale-Up Performances of Polymer Electrolyte Batteries

by

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Paper to be presented at
172nd Meeting of the Electrochemical Society
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The rechargeable high energy density polymer electrolyte battery utilizing a lithium anode, poly(ethylene oxide)-salt complex electrolyte and a V_6O_{13} (Vanadium oxide) composite cathode is being investigated in this laboratory. Cycled tests indicated good adhesion at the anode/electrolyte and electrolyte/cathode interfaces, even after one-hundred deep cycles. Results are also presented on the morphological changes taking place at the cathode. A modified polymer electrolyte with relatively higher room temperature ionic conductivity has also been employed in cells at ambient temperatures. Scaled-up designs are under evaluation.

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Optimization and Scale-Up Performance of Polymer Electrolyte Batteries

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High energy density Li-polymer electrolyte batteries are now the main focus of attention in numerous laboratories around the world. The main attractive features such as the ease of fabrication of the battery components, variable geometry and long shelf life have led to proposed applications spanning across the whole battery product range from microelectronics to electric vehicle.

The cell studied in this laboratory is based on a lithium anode, a polymer-salt electrolyte (poly(ethylene oxide) complexed with $LiCF_3SO_3$) and a V_6O_{13} composite cathode. Cells of area 6.5 cm^2 have been deep cycled at constant current discharge and current limited constant voltage charge at various rates, and their performance assessed. Over a hundred cycles have been obtained at C/5 rate with greater than 75% of the initial utilization of V_6O_{13} being maintained at cycle number 100 (Figure 1). Post-mortem examination of the cell using optical microscopy has shown the Li-electrolyte-cathode layers to be well intact. The electrolyte layer after cycling had become more crystalline in sharp contrast to the normal plastic nature of the starting electrolyte. Nonetheless, this layer was highly smooth and uniform at the interfaces of the cathode and anode.

The cathode was also highly uniform at this interface. It was found that the thinner cathodes resulted in greater stabilization in capacity with continued cycling. The technique for achieving cathodes which can be cast as thin films of 5-10 μm has now been established. This has led to the development of thin film cells scaled-up from 5 mAh up to 200 mAh capacity. This phase of the work is still in progress and 5 Ah cells are under development.

In addition, the polyether electrolyte is being modified so as to achieve a higher conductivity at room temperature. One such modification has led to cells with current outputs of 60 μAcm^{-2} with over 200 μAcm^{-2} predicted. This is comparable to cell performance at 100°C with conventional polymer solid electrolytes.

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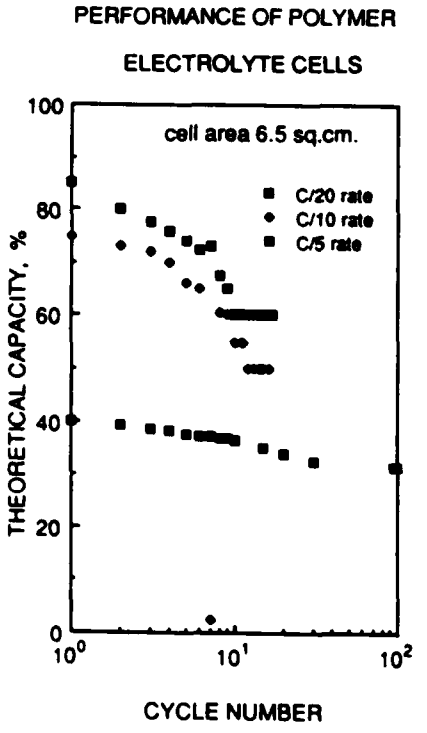

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